Second site visit

D 3.5

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement no 680511. This document does not represent the opinion of the European Union, and the European Union is not responsible for any use that might be made of its content.

Deliverable number

PROJECT INFORMATION	
Project acronym	DREEAM
Grant agreement number	680511
Project title	Demonstration of an integrated Renovation approach for Energy Efficiency At the Multi building scale

DOCUMENT INFORMATION	
Title	Second site visit
Version	
Release date	
Work package	
Dissemination level	

DOCUMENT AUTHORS AND AUTHORISATION	
Lead	Francesco Sacco (RISE)
Contributor(s)	Magnus Hansén (RISE)
Reviewed by	Sabina Manente (ATER) Sophia Tybuβek (1892) Derek Watters (PfP)
Authorised by	

DOCUMENT HISTORY			
Version	Date	Modified contents	Implemented by

Executive summary

The DREEAM approach aims at reaching energy savings of 75% in the building energy consumption: to reach such an ambitious goal it is necessary that the renovation works are performed correctly, therefore the need of checks to assess the quality of the work done. This deliverable is part of WP3, the demonstration part of the project, and most specifically of Task 3.2 “Execution of works”, where RISE has the task of following the progress of the renovation works at pilot sites and provide the Consortium with updates, in form of deliverables, at three stages during the timeline namely at the beginning, mid-term and end of the scheduled interventions on the buildings.

This report is about the second planned visit at the pilot sites to report how the works are progressing and at the same time to do the quality assurance by making visual checks.

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1 Treviso

The second site visit was done at the end of June: at the time of the visit, the renovation works were being performed according to plans on both buildings, with just a small delay due to some financial problems of one entrepreneur firm. ATER has already identified a new construction firm that will carry on the works and would take over at the time of the visit, explaining the short delay in the time schedule. At the time of the writing of the deliverable though, one of the construction companies has gone bankrupt so that works have slowed considerably and a total delay of about three months is expected.

The visit was carried on at the workplace, both at the outside of the building and inside, where multiple apartments were being renovated at the same time.

Checks are carried on periodically by the Architect.

1.1 Material reception and storage

When the materials or components arrive at the workplace, the site manager and his assistances (from ATER) check daily that the DPP label (Dichiarazione di prestazione, performance declaration), verify that the performances indicated on the label correspond to those of the tender (for example that the window has the desired wind resistance grade or transmittance level).

The materials and components were duly labelled, as it can be seen in Figure 1.

Figure 1. Product label on a window

Exploiting the fact that the buildings have a portico in the ground level, most of the materials were stored there to protect them from the weather. Some material was stored in the staircase as well,

taking advantage of the unused surfaces: this was done to make the works into the apartments easier and faster.

Figure 2. Material storage under the portico (left) and in the staircase (right)

1.2 Building envelope

The external XPS insulation has been installed in both of the two buildings: the ongoing work is about rendering the panels. Painting the walls will be the last stage since it is a work that has to be done the same day or with a time interval of maximum one day for every façade so that there will not be colour differences on the same surface. The external wall insulation (EWI) increases considerably the thickness of the wall, as it can be seen in Figure 3. It can be noticed as well the space left for the aerogel panels.

Figure 3. External wall insulation thickness detail

So far, the detailing has been made correctly with some minor imprecisions in the joining of the boards or adherence to the wall (which might be due to the fact that the wall is not perfectly perpendicular to the ground), as it can be seen in Figure 4. The works are not done yet so there is still room for fixing the minor imprecisions.

Figure 4. Adherence of EWI to wall (left) and joints detail for insulation boards (right)

The EWI has been anchored correctly to the wall by using the prescribed number of plastic screws: this was a very important point since too few pins would have made the installation weak and too many would have compromised the moisture safety of the wall, affecting the moisture permeability of the wall, due to the presence of too much plastic, which has a lower moisture permeability. This becomes especially relevant since the old windows are replaced with high-performance ones that account for high air tightness as well: before the building was breathing for the most through the infiltrations provided by the windows, exchanging not only heat but moisture as well with the outside. The darker spots in Figure 5 show where the EWI is anchored on the wall.

Figure 5. Façade with EWI installed, to be rendered and painted

Replacing the window sills would have meant a very disruptive intervention, therefore it was decided to install the new sills on the existing ones, which worked out well. As it can be seen in Figure 6, the result is satisfactory, with a correct sealing at the edges of the window sill. It was decided to lay a thicker layer of aerogel where necessary to meet the same thickness of the surrounding wall.

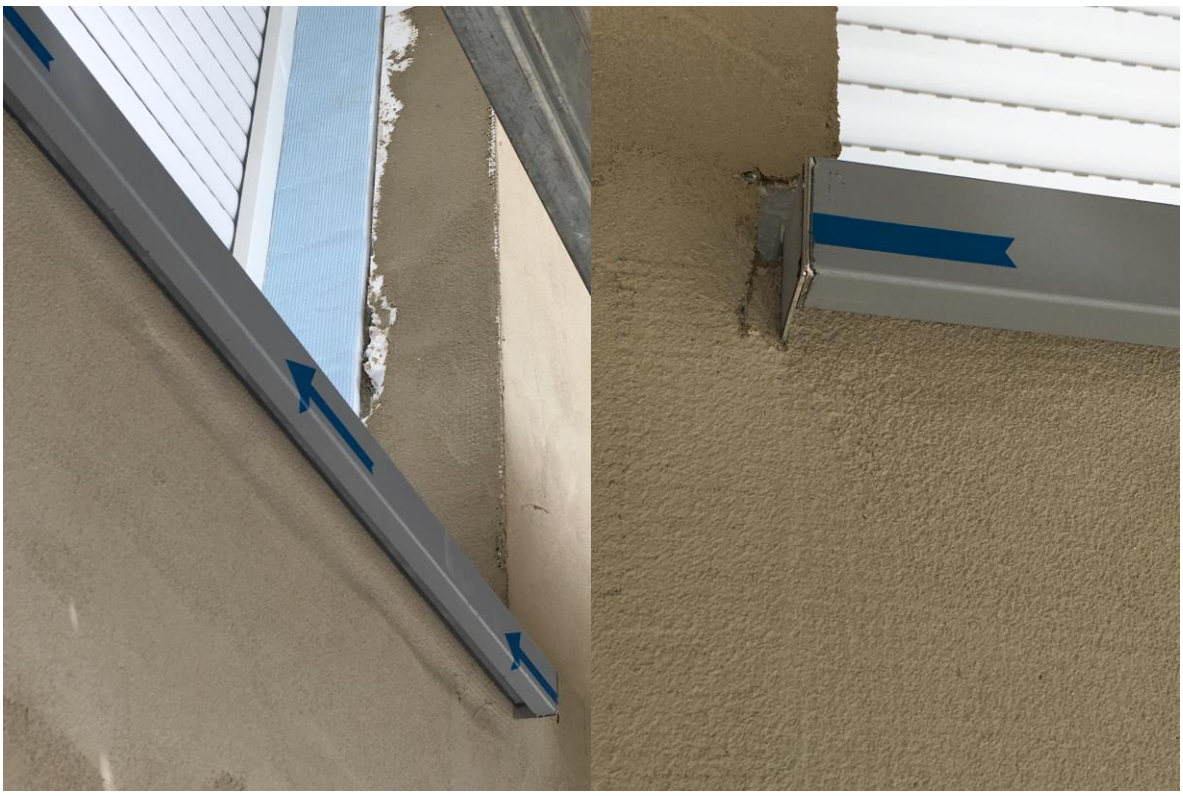

Figure 6. Window sill detail

Windows themselves have been installed correctly. The metal plate (see Figure 7) provides an additional protection from outside rain. It should be said that generally in Italy windows are more protected from rain due to the presence of shutters, which act as a first break again rain and wind.

Figure 7. Door window detail

To see in detail how the render has been applied to the EWI, see Figure 8. It can be noticed the mesh upon which it is applied (light blue). The finishing layer and the painting has to be done on the same day for the whole façade so that there will not be differences in colour due to the different temperature and humidity conditions that might arise if the work is done in separate stages.

Figure 8. Detail of installation of render on the EWI through a mesh

It was noticed during the visit that, whenever there was a perforation in the building envelope, due for instance to pipes or screws, special care was taken to insulate it with foam, to avoid thermal bridging and improve air tightness. The figures below give some examples (finishing is still to be done).

Figure 9. Details of perforations in the building envelope

Figure 10. Details of perforations in the building envelope

1.3 Building systems

New gas boilers have been installed in the apartments, and the old piping has been replaced since leaks were reported.

Figure 11. New gas boiler (left) and piping system

All the works have been performed with the tenant living in the apartments. Mechanical ventilation was also installed, together with a small fuse box for its control. As it can be seen in Figure 12, the piping (well insulated) runs on the ceiling and it will be hidden by a false ceiling.

Figure 12. Air handling unit (left) and detail of insulated air ducting

The ventilation unit recuperates heat from the exhaust air, making it very effective. The change of windows and doors will make the apartments more airtight, which is a prerequisite for the installation of mechanical ventilation. It would be interesting to do a blower door test to check the increase in air tightness for the apartments.

The box containing the roller shutters was also insulated, as it is often overlooked and a critical thermal bridge as the wall is thinner.

Figure 13. Detail of roller shutters box

1.4 Roof

As for the renovation of the roof, the cold attic was insulated with mineral wool, a new waterproof membrane was installed and the roof tiles have been replaced where broken (the ones in a good state were just put back). Then solar collectors and photovoltaic panels were mounted. A metal safety rope was also mounted at the top in order to allow for safe maintenance works.

Figure 14. Solar collectors (left, with the safety rope at the top) and photovoltaic panels

The works were not completely done yet but as far as we could see the details were satisfactory, as shown in Figure 15.

Figure 15. Piping for the solar collectors (left) and gutter detail

The detailing in correspondence of the EWI was not done yet as the roof felt was installed since it cannot be sealed directly to the XPS.

Figure 16. Detail of EWI at the roof level

1.5 Control of the critical moments identified in D3.3

The critical moments that were identified during the first site visit were as follows. For every point (in italic), feedback is given.

External wall insulation:

- *Restore accurately the plaster of the external wall where damaged, to allow for correct installation of the external insulation.*

  We could notice that repairing works were done correctly, as in Figure 17.

Figure 17. New plaster (blue) on the external wall

- *When the finish is applied directly on the insulation (on mortar), then it has to give adequate protection against driving rain. It has been proved that building a completely rainproof rendered façade it is almost impossible: some water during hard rainfall could get in through possible cracks or connections. Since there is no ventilated air gap behind the render, it will take some time for the water to dry. It should be verified through calculations that the critical values of relative humidity for the wall materials are not exceeded.*

  No calculations were performed but the dry weather allowed for a safe installation, and the building was sufficiently protected by the scaffolding anyway.
- *Every perforation through the insulation layer has to be sealed correctly to avoid thermal bridging and moisture penetration (condensate pipe, overflow outlet, waste water outlet, ventilation ducts)*

  Ok, see report.
- *Install the aerogel panels in the window reveals by paying attention to the joining and sealing to avoid thermal bridging*

  Ok, see report.

Windows replacement:

- *Install windows that have the desired properties (U-value, soundproofing and so on) certified*

  Ok
- *Make sure that the sill on the internal side does not obstacle the warm airflow from the underlying radiator (to prevent condensation and cold drafts)*

  Ok
- *Place the window close to the inside of the wall*

  Ok
- *Make sure that there is proper sealing between the window frame and sash*

Ok, see report

- *When installing the windows, apply a two-steps approach for waterproofing the joints, which means to separate the rain protection to the wind protection function: the first part* of the seal has just the aim of preventing the raindrops for directly getting in)

  Could not check this directly but the result looks good

- *When installing the new insulated aluminium window sill, pay attention to correct sealing to ensure water- and airtightness.*

  Ok, see report

Roof/attic insulation

- *Avoid thermal bridging when insulating the cold roof slab, adjust insulation thickness to provide uniform U-value*
- *Make the attic slab as airtight as possible when insulating it to prevent warm moist air from the lower floors from getting into the common room*

Not installed yet

There is an “additional” critical moment, namely the delay in the works due to the bankruptcy of a contractor. This should not affect the technical quality of the works but rather the patience of the tenants.

2 Berlin

The second site visit was done mid-September; at the time of the visit, works were going on according to plan. The renovation works are performed by letting the tenants staying in their apartments; some other tenants moved temporarily to guest houses provided by 1892.

The visit comprised an inspection of an apartment where the windows had just been replaced and the accessory works were being performed, an inspection of the newly-insulated roof, of the stairways and corridors to allow for the mounting of the cables from the solar panels (not installed yet), plus a descent to the control room for the electrics and a stop at the site where a new building is being erected.

The site manager does personally controls on the works.

2.1 Installation of new windows

The old windows had already been taken away and replaced by the new ones: it was possible to see how the works for air tightness and finishing were performed, since they were still ongoing at the time of the visit (windows have been installed the very morning).

The outside has been sealed correctly, as it can be seen in figure. The silicone seal was still drying at the time of the visit, and we could notice that it was done very accurately.

Figure 18. Outside detail of window sealing

There is still some detailing to do on the outside window-wall connection, as it can be seen in Figure 19.

Figure 19. Detail of lateral window sealing

It was possible to see how the air tightness measures were about to be implemented: the foil (in orange in the figure) was exposed before finishing the installation. We noticed that, even though the work is not finished, it could have been done better to guarantee a complete air tightness. As it can be noticed in Figure 20, there should be more foil so that it would be fastened to the flat horizontal part for better adhesion (the overlap between the two sheets is sufficient though).

Figure 20. Window sill detail

The foil has been installed more correctly in another window, where it has more surface on the sill, as shown in Figure 21. However, it would be recommended to use more foil so that it would cover almost all of the sill for better adhesion and consequent air tightness.

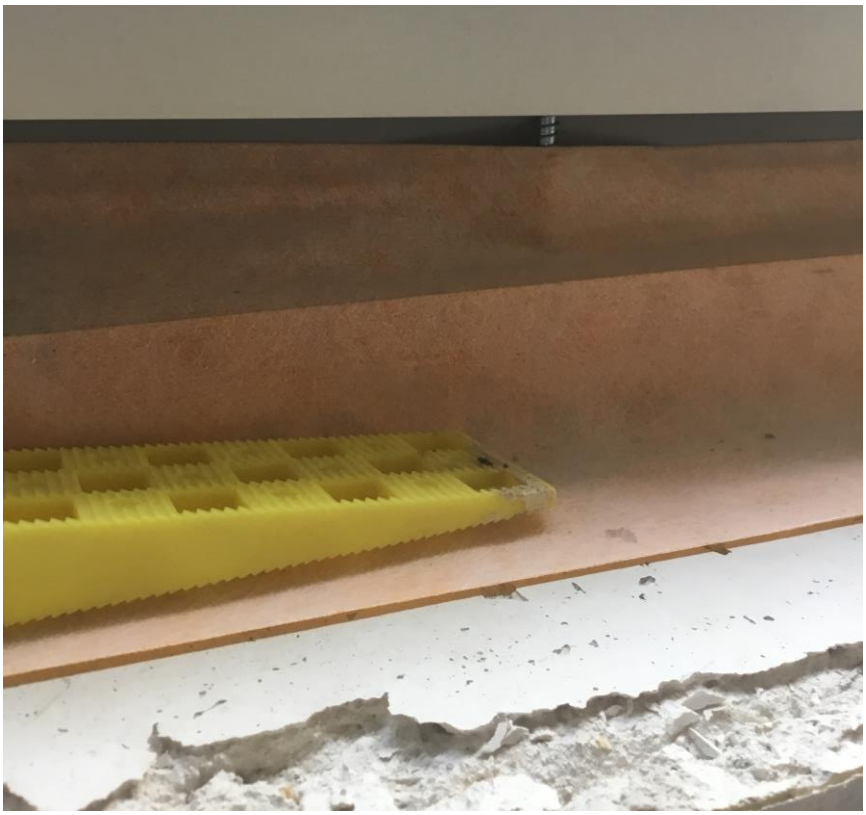

Figure 21. Window sill detail

The foil should be also crammed with more care around perforations and joints, as it is shown in Figure 22.

Figure 22. Detail of junction between floor, wall and door window

Figure 23. Detail of window air tightness: the red circle indicates the position of the screw

It can be noticed that the foil is not crammed accurately in the space between the door window and the wall, and there is also space between the wall under the window and one of the screws that were used for the installation, as shown in Figure 22.

This could be an issue in severe climates such as Sweden, with thickly insulated walls where air tightness is paramount to ensure moisture safety, comfort and energy efficiency through ventilation. In the considered building typology, it should not be a huge problem, given the presence of other sources of air infiltration.

A blower door test could be made to check the air tightness of the apartments prior and after renovation, to see the impact of the new windows.

2.2 Installation of roof insulation

At the time of the visit, the works were completed: the roof was provided with insulation and a new covering to allow the installation of solar panels (the works have not started yet). Overall the work was done correctly, and it looks like the sealing of the roofing felt is watertight, as shown in Figure 24.

Figure 24. Details of joints in roof covering membrane

There are some details though that might not ensure a perfect water tightness of the roof, especially at the sides, as shown in Figure 25.

Figure 25. Detail of metal plates and corner joints in roofing membrane

Some parts still needed the finishing details, as shown in Figure 26.

Figure 26. Unfinished border detail

Since there are some pits for runoff of rainwater, as shown in figure Figure 27, it would be interesting to see if some kind of test had been planned to make sure that they happen to be at the lowest level in the roof surface for correct functioning and to prevent rainwater from staying on the roof after precipitations.

Figure 27. Pit for rainwater runoff

A further check of the roof is needed at the time of the installation of solar panels.

2.3 New energy meters

In order to use the electricity that will be produced by the PV panels, the apartments were being provided with new energy meters and cabling necessary for its distribution.

Figure 28. Cabling and meters

The cables are being routed in the apartments, through a wooden structure with metallic guides, as shown in Figure 29.

Figure 29. How the cables are laid across the floors

2.4 Control of the critical moments identified in D3.3

The critical moments that were identified during the first site visit were as follows. For every point (in italic), feedback is given.

Renewal of façade sealing:

- *Calculate the small dilatations/contractions that might occur in the façade boards due to temperature and humidity to correctly dimension the new joints*
- *Have the concrete surface where the sealant will be installed level and free from superficial pores, to guarantee good adhesion and therefore waterproofing*
- *Use the right sealant for the specific application*

Not applicable anymore, sealings will not be renovated. They do not look in very good conditions though so a replacement might be needed in the near future.

Windows replacement:

- *Install windows that have the desired properties (U-value, soundproofing and so on) certified*

  Ok
- *Make sure that the sill on the internal side does not obstacle the warm airflow from the underlying radiator (to prevent condensation and cold drafts)*

  Ok, even though radiators are quite recessed
- *Place the window close to the inside of the wall*

  Ok
- *Make sure that there is proper sealing between the window frame and sash*

  Ok, just the airtightness of the frame has to be improved, see report.
- *When installing the windows, apply a two-steps approach for waterproofing the joints, which means to separate the rain protection to the wind protection function: the first part of the seal has just the aim of preventing the raindrops for directly getting in)*

Roof:

- *When renovating the waterproofing, avoid direct installation of the bitumen layer on cellular plastic, both due to the risk of burning when applying the bitumen and also because cellular plastic shrinks under the influence of the sun, which will turn into leaks between the insulation boards and therefore heat losses. It is recommended to place at least 20mm of mineral wool on top of the insulation to protect it.*

  Bitumen layer installed correctly, joints look ok.
- *Moisture safety of the roof depends mostly on additional components such as gutters, vents, flashings and how the waterproofing is sealed around those components. Make sure that the perforations are sealed appropriately*

  Some details should be improved, as reported.

- *Solar panels installation to ensure that the fastenings are correctly dimensioned to withstand wind loads and that they will not impact on the weatherproofing of the roof*

  Not installed yet

Terrace roof:

- *Make sure that any surface treatment on the other side of the slab is more permeable to vapour than the vapour barrier.*

  Not checked
- *Keep the isolation material safe from moisture and damage during the installation phase*

  Ok
- *Bring the waterproofing layer high enough at the terrace borders, and protect it from damage under construction.*

  Ok
- *Check the effectiveness of the drainage system at the windows base: it is usually not optimal to have the terrace at the same level as the apartment floor or above as it will facilitate inwards leakage.*

  Not checked

3 Padiham

The visit was performed in September, as works were soon to be finalised. Thanks to a very dry summer the works could go on with no delay and the goal of being done in October was considered to be doable. As a side note, it was really impressive to see how the whole neighbourhood had changed aspect due to the renovation, the feeling was of being back into a Scandinavian residential district.

The visit comprised an inspection of both internal and external works, to assess how the renovation measures were implemented onsite. It was possible for the tenants to live in the dwellings during the renovation works.

Places for People has a very efficient way of doing checks to ensure that work goes according to plans: a responsible, in this case the Contract Delivery Manager, controls personally 10% of the work milestones (chosen randomly) and will report any deviation to the site manager so that the chances of discovering problems during the final visit will be very low.

3.1 Material storage

We noticed that only mineral wool was stored outside exposed to rain, see Figure 30. It was still wrapped in its original packaging so there was no problem with that. Mineral wool is a material that is not affected by water anyway so there was no risk for damage (but it should be dry at the time of installation).

Figure 30. Mineral wool storage

3.2 Building envelope

The EWI was installed on the existing brick wall and rendered, as seen in Figure 31 where the detailing is still to be done. That resulted in a complete facelift of the district.

Figure 31. Detail of external wall insulation (left) and the result on a completed house

There is still some work to do in the passage under some houses but the insulation was anchored correctly to the existing substrate. It will not be rendered but rather fixed with boards, as shown in Figure 32.

Figure 32. EWI being installed in the passage, and the completed work with wooden boards

The work is being done with satisfactory attention for details, to prevent moisture related problems. Critical points as junctions and perforations are being sealed, as shown in Figure 33.

Figure 33. Details on the building envelope

The absence of a protruding roof exposes the building somewhat more to rain but measures were taken to ensure moisture safety, as shown in the detail around the roof fascia and above the entrance

door, as shown in Figure 34. We could not get to the roof, but it looks as if there is enough margin for the metal plates to extend over the joints.

Figure 34. Roof fascia detail (left) and door entrance. Notice the position of the metal plates

Lots of ridge tails on the roofs were broken and since those roof tiles are not produced anymore, a house was reroofed completely to use its tiles as spare parts for the other houses. As additional works, the existing canopies were cleaned and gutters fixed.

What we could assess in more detail is the window installation. We could not follow the very installation itself as we did in Berlin but the result looks good, as the sealings around the frame and sill are done correctly on both sides, as shown in Figure 35 and Figure 36.

Figure 35. Windows detail, outside

Figure 36. Windows detail, inside

3.3 Building systems

Radiators were being installed in the correct positions, according to plans, as shown in Figure 37. It is possible to set the temperature and to program them. There is a small electric heater in the bathroom as well just for enhanced comfort.

Figure 37. New installed electrical radiators

New efficient boilers were installed in all properties, depending on if they were electric or gas-fired. They are also better insulated than the old ones, which accounts for an improved energy savings. In a dwelling an innovative gel-based heat exchanger (the box on the ground in Figure 38), basically a heat battery that will work with any heat source, is about to be tested. It is connected to the photovoltaic system and uses the electrical charge provided by the panels to set the heat off.

Figure 38. New boiler and Sunamp heat battery box

In the buildings where photovoltaic panels are installed (1.2 kWp), there is a small panel where the tenant can check the energy production.

Figure 39. Panel for photovoltaics energy production monitoring

The new mechanical ventilation unit is installed in the cold attic, which has been insulated with loose wool, as it can be seen in Figure 40. Since the inverter for the solar panels is mounted there, a smoke detector was installed for safety. We noticed that the wool is put in a somewhat disorderly way but it should not be a problem as long as the minimum thickness is ensured and it does not interfere with the air intake duct.

Figure 40. Cold attic insulation. Notice the smoke detector (left) and the weatherproofing close to the roof eave (right)

The ventilation concept is to have something “semi-passive”: the most important feature of the ventilation system is to take humidity out of the building. Figure 41 shows the air intake inside the dwelling, located on the second-floor ceiling.

Figure 41. Ventilation terminal on the 2nd floor ceiling

The other works included the replacement of the old electric shower with a new one and installation of a simple exhaust fan in the bathroom (not connected to the main ventilation system), for sanitary and moisture reasons. It was not necessary to retile the bathroom as the tiles were deemed to be in good state, which we could confirm. The new shower comes with a plank that covers the void left by the former electric shower, which was sealed correctly to the tiling to avoid water infiltration.

3.4 Control of the critical moments identified in D 3.3

The critical moments that were identified during the first site visit were as follows. For every point (in italic), feedback is given.

External wall insulation:

- *When the finish is applied directly on the insulation (on mortar), then it has to give adequate protection against driving rain. It has been proved that building a completely rainproof rendered façade it is almost impossible: some water during hard rainfall could get in through possible cracks or connections. Since there is no ventilated air gap behind the render, it will take some time for the water to dry. The PermaRock system has good permeability which should allow drying; anyway it should be verified through calculations that the critical values of relative humidity for the wall materials are not exceeded*

  No calculations. A dry summer ensured easy installation of the EWI. Some dubious outside storage as reported but mineral wool was still tightly packaged.

- *Every perforation through the insulation layer has to be sealed correctly to avoid thermal bridging and moisture penetration (condensate pipe, overflow outlet, waste water outlet, ventilation ducts, gas meter box and so on)*

  Sealings made correctly, as reported

- *Provide adequate protection to the external insulation where the roof overhang is not sufficient to cover the new insulation layer, as indicated in the specs*

  Metal protections to flush rainwater could not be inspected closely but they looked well-installed as shown in the report.

Windows replacement:

- *Install windows that have the desired properties (U-value, soundproofing and so on) certified*

  Ok

- *Make sure that the sill on the internal side does not obstacle the warm airflow from the underlying radiator (to prevent condensation and cold drafts)*

  Ok, no radiator

- *Place the window close to the inside of the wall*

  Ok

- *Make sure that there is proper sealing between the window frame and sash*

  Ok

- *When installing the windows, apply a two-steps approach for waterproofing the joints, which means to separate the rain protection to the wind protection function: the first part of the seal has just the aim of preventing the raindrops for directly getting in)*

  Could not check the process but the result looks very satisfying, as reported.

- *Careful sealing of the extender frame*

  Ok, as shown in report

Roof/attic insulation

- *Check with calculations the relative humidity values that might occur at the joists and make sure that they will not exceed the critical threshold of 75% (or less if a safety factor is desired)*

  No calculations were done

- *Make sure that the new insulation does not block the ventilation intakes at the attic*

  Ok, see report

- *Make the attic slab as airtight as possible when insulating it to prevent warm moist air from the lower floors to get into the cold attic and condensate.*

  Ventilation system in place to take care of it

4 Conclusions

This deliverable was about the second site visit, performed by RISE's personnel and part of the quality assurance. It had the double purpose of reporting to the project leader and the consortium about the state of works and to do the checks to ensure that the DREEAM approach is followed, to reach the goals set by the building owners.

It was observed throughout the sites a high level of works performance, consequence of the care that was put by the building owners in the tendering process to choose a construction firm that would guarantee a good result and on-time delivery. The problems in Treviso were unexpected but ATER is dealing actively to find a solution and the overall delay should not be more than three months. Individual feedback was given to the building owners when necessary.

A blower-door test would have been recommended to check the air tightness values prior and after renovation, especially when renovating a pilot apartment so that further improvements can be taken during the course of the project if the overall value does not meet the expectations.

The critical points identified in D3.3 were checked wherever possible and the outcome was reported at the end of the relevant chapter for every demo site.